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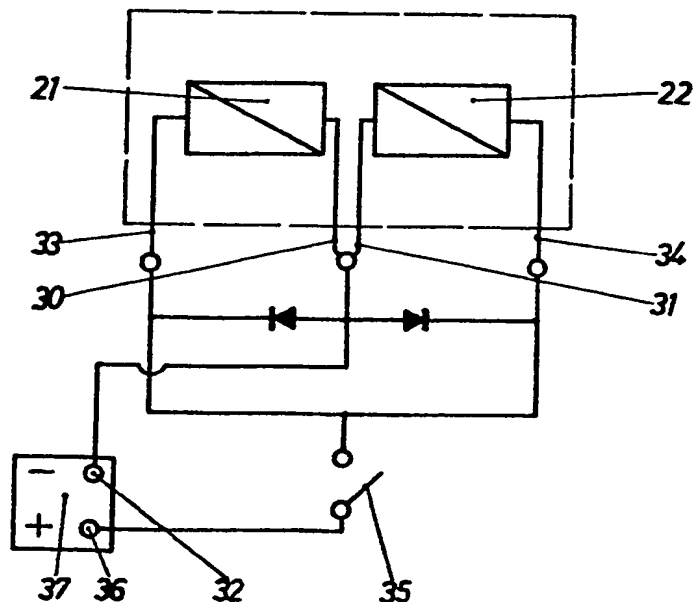
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(54) Reversible drive unit of agricultural machine

(57) An agricultural machine is equipped with a safety system for the avoidance of accidents concerning, and damage to, a driven operating device. The machine comprises a reversible drive unit for driving at least one such device, the drive unit comprising two electromagnetically

operable clutches (21, 22) for forward and reverse driving of the operating device. The clutches (21, 22) are mounted on an output shaft of the drive unit and can be engaged simultaneously through a switch (35), which connects the clutches to the poles (32, 36) of a current source (37) by way of conductors (30, 31; 33, 34), thus locking the output shaft against rotation.

Fig.3



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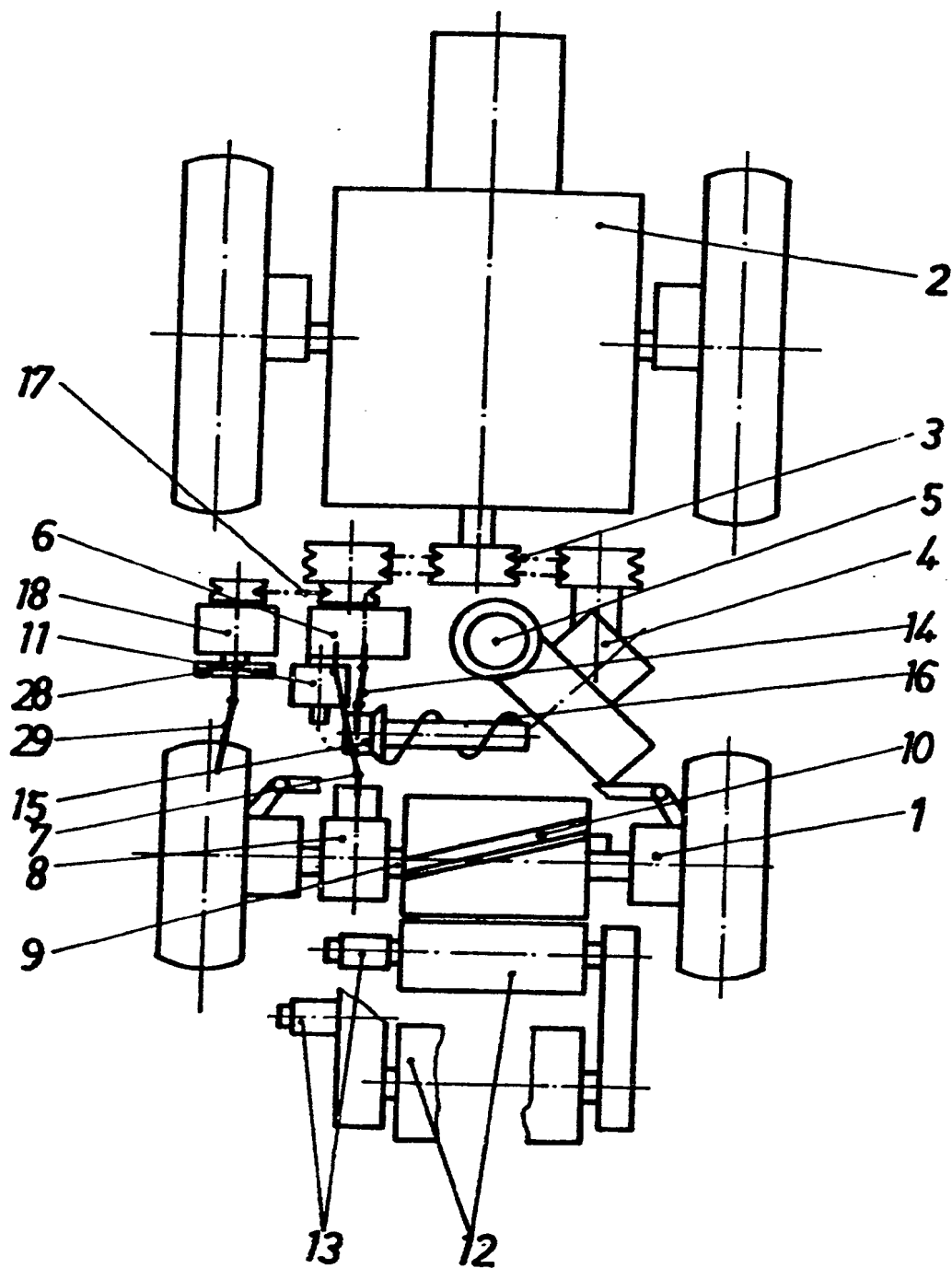
Fig. 1

Fig. 2

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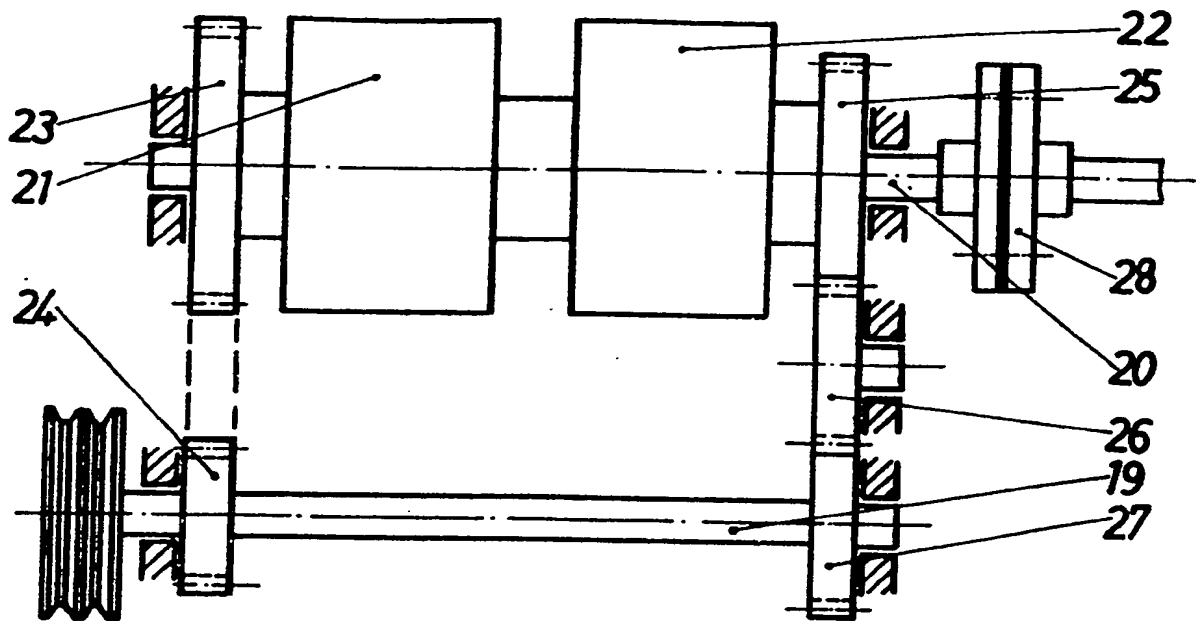
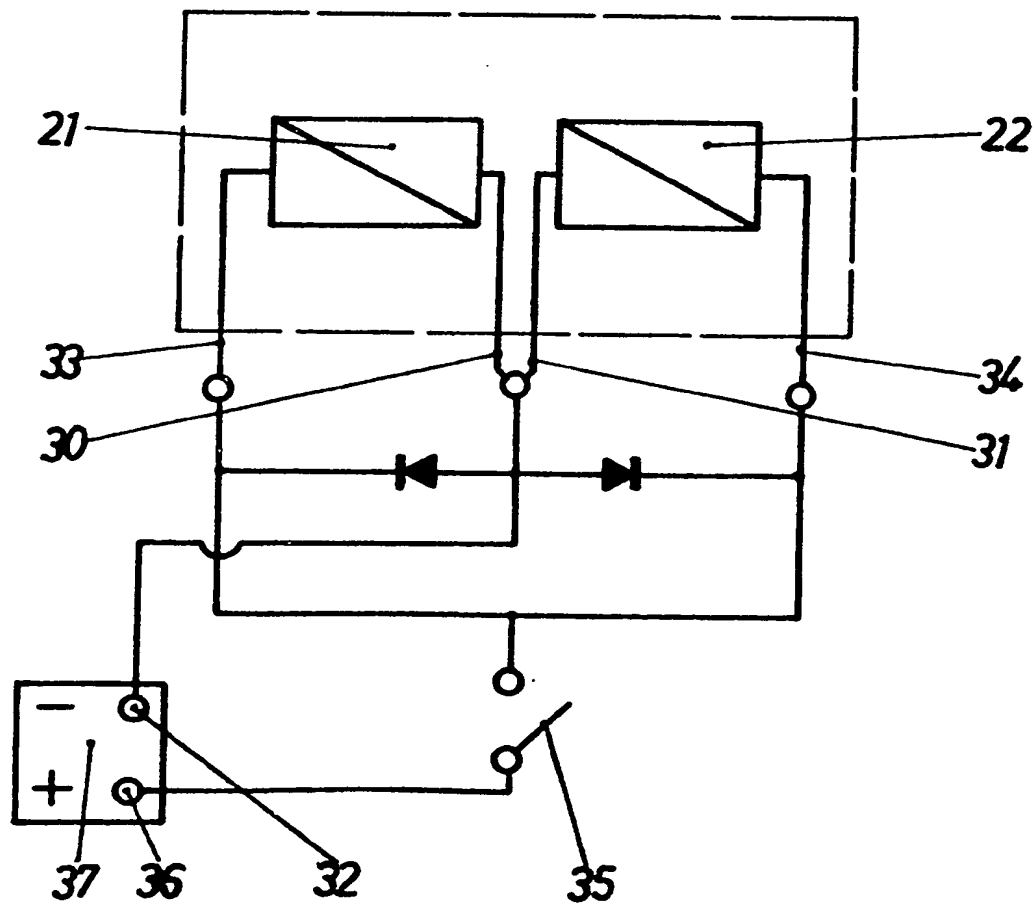


Fig. 3



SPECIFICATION Agricultural machine

The present invention relates to an agricultural machine, for example a chaff cutter.

5 Different drive systems are known for the drive of operating devices and the wheel drive of automotive field chaff cutters. Thus, in German (Dem. Rep) patent specification no. 75 171 there is disclosed a drive system in which the chaff-cutting drum is driven through a belt coupling from an engine arranged transversely to the direction of travel. A second belt drive from the engine leads to an intermediate shaft, from which on the one hand the wheel drive is taken off through a variable gear and a shift gear and on the other hand the drive of the feed system, inclusive of an adaptor, is taken off. The latter goes through a speed-changing and reversing gear unit which provides an output at a constant rotational speed for the adaptor drive and a controllable output for the drive of the feed system, whereby different chaff lengths can be obtained. The forward running or reverse running of the feed system and partially of the adaptor is achieved by two clutches which are arranged on the input shaft of the speed-changing and reversing gear unit, one clutch being engaged at a time or both disengaged selectably by means of a shift rod. The power flow from the input shaft to the output shaft at constant rotational speed goes either through the first clutch and directly engaged spur gears or through the second clutch and spur gears engaged via an intermediate gear, so that opposed rotational directions are provided. When both clutches are disengaged, the power flow is interrupted at this point and the feed system and the adaptor are at a standstill. The switchable output shaft is in operative connection through a gear shift lever housing with the output shaft to the adaptor drive so that, apart from forward and reverse running, different output rotational speeds for different chaff lengths are additionally available.

45 This drive system has a number of sources of danger during carrying out of repairs or hand clearance of blockages in the flow of harvested stock. If the operator, before leaving the driving cab of the machine, switches off the operating devices, i.e. uncouples the belt coupling and disengages both clutches, the chaff cutting drum requires several minutes to come to a standstill, whereas the feeder system and adaptor come to a standstill relatively quickly. There are thus risks for the operator, as accidents can occur during the time the chaff cutting drum is running down or as a consequence of unintended or automatic initiation of the operation of the feed system and adaptor. The latter is not rare in practice, due to inadequacies of the mechanical actuation of the clutches or due to a clutch not being completely disengaged as a result of obstruction with harvested stock. Thus, the feed system, due to removal of the obstruction or to vibration of the engine and thereby of the entire machine, may

65 suddenly start up again. In recognition of this danger, it has been prescribed in operating instructions that the engine is to be switched off before carrying out the above-mentioned operations, but this is not always adhered to and the risk of accident is thus not eliminated.

70 Moreover, the disadvantage of the free running down of the chaff-cutting drum remains, as the braking of the drum with the engine switched off is not possible due to uncontrolled vibrations in the power transmission component of the engine.

75 A further drive system is disclosed in German (Dem. Rep.) patent specification no. 98 598, in which the drive for the operating devices is taken off through two belt drives from an engine arranged longitudinally in the direction of travel. One belt drive branching off from the engine output drives the chaff cutting drum through a distributing and speed-changing gear unit and a mitre gear. The drives to the feed system and to the adaptor are derived from longitudinal shafts from the distribution and speed-changing gear unit. Arranged on the input shaft thereof are two clutches of the same function as described in the German specification no. 75 171.

90 The drive of a thrower blower takes place from the engine output through the other belt drive via a mitre gear associated with the thrower blower.

With regard to accident risks, this drive system can be looked on as being the same as that according to the German specification no. 75 171, as after disengaging of the engine coupling at the engine output, the operating devices run down freely and are not secured against possibly restarting while the engine is running. In both described prior art machines, it is also disadvantageous that the operation of the several actuating elements is necessary for the orderly stopping of the machine, which presupposes completely correct controlling by the operator.

100 For automatic stopping of the engine, the use of electrical contacts in connection with electromechanical actuating equipment is also known, the arrangement being such that on triggering of these contacts the fuel supply to the engine is interrupted. Contacts of that kind can be mounted on, for example, the driver's seat, the opening to the thrower blower, the cover for the chaff cutting unit, on protective grids, and the like. The disadvantages of arrangements of that kind are that too much time elapses between actuation of the contacts and standstill of the engine, these components require additional constructional effort, and free running down of the operating devices is not prevented.

105 A further accident prevention device is disclosed in German (Fed. Rep.) patent specification no. 27 30 031, this device providing an acoustic warning. The drive of the chaff cutting drum takes place through a ratchet so that a warning signal can be heard after switching-off of the drive until complete standstill of the operating devices. The disadvantage of this solution is that the operating devices still run down freely, so that the risk of accident remains. Furthermore, the

acoustic warning device also requires increased constructional effort.

There is accordingly a need for a method of switching-off the drive system of an agricultural machine which avoids the risk of accident due to rotating operating devices, requires only a simple operation and imposes small constructional requirements. Such a method should enable the rotating operating devices to be brought to a standstill in the shortest time and prevent unintended resumption of their operation.

According to the present invention there is provided an agricultural machine provided with a reversible drive unit for driving at least one operating device in a selectable one of two opposite rotational directions, the drive unit comprising an output shaft provided with two clutches each engageable to enable drive to be transmitted to the shaft in a respective one of the directions and control means actuable to cause the clutches to be simultaneously engaged so that drive of the shaft in one direction opposes drive of the shaft in the other direction and leads to locking of the shaft against rotation.

Expediently, the clutches are electromagnetically operable, and gears, for example spur gears, are rigidly connected with the clutches and stand in operative connection with an idler shaft, in one case through direct engagement and in the other case through an intermediate gear. One conductor of each of the electromagnetically operable clutches is preferably connected directly to the same pole of a current source and the other conductors are led together through a switch to the other pole of the current source. In place of an electrical circuit there can, of course, be used a pneumatic or hydraulic actuating means.

In a preferred embodiment, the drive unit is incorporated in a drive system of the machine so as to bring a number of operating devices driven by the system to standstill at the same time as the or each operating device driven by the drive unit. In an example of such a system, the drive branches off from the engine of the machine for drive of a thrower blower on the one hand and all other operating devices on the other hand. This is achieved by a belt drive in triangular arrangement. The thrower blower receives its drive directly from this belt drive through a bevel gear. A second output of this belt drive branches at a V-belt pulley to drive an adaptor through the reversible drive unit and a chaff cutting drum, feed rollers and a feed worm for the thrower blower through a speed changing gear unit. This arrangement is, of course, capable of variation, it merely being necessary for the reversible drive unit to be included in the drive system for the operating devices to be brought to standstill, and for these devices to be in operative connection among one another. The various operating devices of the machine are brought to standstill simply by simultaneous engagement of the clutches of the reversible drive unit. Briefly displaced in phase before the closing of the switch, an engine clutch, which is present in every

such agricultural machine, is disengaged. Due to the simultaneous coupling to the output shaft of the drive unit of two gear stages of opposed rotational directions, there is immediate braking and rapid coming to standstill of all operating devices on the basis of the action-reaction principle. The magnitude of the braking moment is equal to twice the sliding friction moment of one clutch. The time to standstill of the operating devices depends on their kinetic energy, the size of the clutches and their operating rotational speed. In chaff cutters, times of about 1 second can be achieved.

In a machine embodying the invention, the elimination of blockages in the flow of harvested stock or carrying out of repairs of the operating devices can be effected without risk of accident due to actuation of the devices. As a result of the substantial braking moment applied to the engine, the engine is not in a position of allowing the operating devices to restart even if the engine clutch should engage of its own accord. A further advantage is the simple control possible by a single switch and the minimum additional constructional effort required to provide such a switch by comparison with the conventional drive systems. Apart from functioning for accident prevention, the safety system incorporated in the machine also serves to protect the operating devices against destruction by foreign bodies. The above-mentioned short time before standstill of the operating devices prevents excessive damage to the chaff cutting drum or thrower blower due to continuing contact with a foreign body after shutdown of the devices. By means of a detecting device which provides a signal to actuate the switch when detecting the presence of a foreign body, the protection of the operating devices against foreign bodies can be automated.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a schematic plan view of a chaff cutter according to the said embodiment, showing the drive system of the chaff cutter;

Fig. 2 is a schematic cross-section of a reversible gear drive unit in the drive system; and

Fig. 3 is a circuit diagram of the circuit for control of electromagnetic clutches in the drive unit.

Referring now to the drawings, there is shown an automatic field chaff cutter 1 with an engine 2 arranged longitudinally in direction of travel of the cutter 1. Coupled to an output of the engine is a belt drive 3 with, in triangular arrangement, one drive and two driven pulleys. A thrower blower 5 is driven from one of the driven pulleys through a bevel gear 4. From the other hand driven pulley a speed-changing spur gear unit 6 is driven, and an articulated shaft 7, which is coupled to the gear unit 6, drives a mitre gear 8, which is coupled to a shaft 9 of a chaff cutting drum 10. The gear unit 6 provides three forward speeds and one reverse speed in the drive of the drum 10.

to the gear unit 6 is a hydraulic pump 11 for the drive of hydraulic motors 13 arranged on feed rollers 12.

A further drive is taken by means of an articulated shaft 14 and a bevel gear 15 to a feed worm 16 of thrower blower 5.

For driving an adaptor (not shown), a belt drive 17 goes from the gear unit 6 to a reversible spur gear drive unit 18, which comprises an idler input shaft 19 and an output shaft 20.

Electromagnetically operable clutches 21 and 22 are mounted on the output shaft 20. A spur gear 23, which is connected to the clutch 21, meshes directly with a spur gear 24 on the input shaft 19, and a spur gear 25 connected to the clutch 22 is engaged, through an intermediate gear 26, with a spur gear 27 on the input shaft 19. Due to this intermediate gear, the gear train composed of gears 25, 26 and 27 transmits drive from the shaft 19 to the shaft 20 in the opposite rotational direction to the drive transmitted by the gear train composed of the gears 23 and 24. The adaptor itself is driven from the output shaft 20 through a friction clutch 28 and an articulated shaft 29.

Two conductors 30 and 31 of the clutches 21 and 22, respectively, are connected in common with one pole 32 of a single current source 37, and two further conductors 33 and 34 of the clutches are connected with the other pole 36 of the source 37 by way of a switch 35.

As will be appreciated, when the switch 35 is closed, the two clutches 21 and 22 are engaged simultaneously, so that drive is transmitted from the shaft 19 to the shaft 20 through both trains of gears. As these gear trains provide drive in opposite directions, one drive opposes the other and locks the shaft 20 against rotation. Because the drive unit 18 is operatively associated with all other drives of the drive system of the machine, the locking of the shaft 20 against rotation causes the other drives to be locked in a similar manner.

In addition, separate switches (not shown) are provided for selectively engaging the clutches 21 and 22 to provide forward running and reverse running as may be required, and for disengaging both clutches to enable the adaptor to idle.

CLAIMS

1. An agricultural machine provided with a

reversible drive unit for driving at least one operating device in a selectable one of two opposite rotational directions, the drive unit comprising an output shaft provided with two clutches each engageable to enable drive to be transmitted to the shaft in a respective one of the directions and control means actuable to cause the clutches to be simultaneously engaged so that drive of the shaft in one direction opposes drive of the shaft in the other direction and leads to locking of the shaft against rotation.

2. A machine as claimed in claim 1, wherein the drive unit comprises a respective gear train operatively associated with each of the clutches to transmit drive from a common idler shaft.

3. A machine as claimed in claim 2, wherein the gear trains each comprise a first gear coupled to the respective clutch and drivably engaged with a second gear on the idler shaft, the first and second gears of one of the trains being directly interengaged and the first and second gears of the other train being interengaged by way of an intermediate gear.

4. A machine as claimed in claim 3, wherein the gears are spur gears.

5. A machine as claimed in any one of the preceding claims, wherein the clutches are electromagnetically operable.

6. A machine as claimed in claim 5, wherein the clutches are connected to a common power source, the control means comprising electrical switch means operable to make and break the connection.

7. A machine as claimed in any one of the preceding claims, comprising at least one further drive unit for transmitting drive to another operating device, the further drive unit being so operatively coupled to the first-mentioned drive unit as to be prevented from transmitting drive while the output shaft of the first-mentioned unit is locked against rotation.

8. A machine as claimed in any one of the preceding claims, the machine being a chaff cutter.

9. An agricultural machine substantially as hereinbefore described with reference to the accompanying drawings.